

Using web quizzes to assess concept understanding and pacing the students

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Invited to Focus Session: Education for Electromagnetics,
Organized by Ari Henrik Sihvola

Abstract

We have used the free web application moodle (<http://moodle.org>) to publish short questionnaires after each week of teaching. The students' understanding of the concepts discussed during the week are tested by different types of questions, typically multiple choice, short calculations, matching of alternatives etc. The students' answers are graded by the system, and some automatic feedback can be given. This provides the students with a tool they can use to check their understanding, and also helps keeping them in phase with the intended pace of the course. We have found it most useful to test only the basic concepts; the students' ability to synthesize different concepts is tested with other means like traditional exercises, since this is seldom suited for automatic grading.

The system has been used and evaluated in different types of courses: large compulsory courses (around 100 students, compulsory in year 1 or 2), and in small advanced courses (around 20–40 students, elective in year 4). It is observed that the talented students do not need to spend much more than a few minutes with the tests, whereas the struggling students may spend up to hours with the questions. From our evaluations, we conclude that 1) the students appreciate modern course elements that are well aligned with the rest of the course, 2) the system has encouraged them to spend time with the subject matter, and 3) the teacher has to do relatively little work once the questions have been formulated. The latter point means this system can provide a large group of students with feedback, without necessarily increasing the workload of the teacher.



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Background

Teaching environment at the Department of Electrical and information Technology, Lund University, Sweden:

- ▶ Programme organisation (many departments per program, 40–120 students)
- ▶ 84 courses at the department (for 10 programmes), about 70 faculty personnel, equivalent to about 500 full time students per year
- ▶ Most teaching is “traditional”, based on lectures, tutorials, and labs

In this presentation I will describe a new teaching activity we have tried for several years, using a typical ICT aid.

Web quizzes

ETE115_2013: Elektroniska frågor, test 1 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

ETE115_2013: Elektroniska fråg...

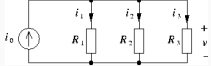
moodle.eit.lth.se/mod/quiz/attempt.php?q=293

Google

6

Ordna strömmarna i_1 , i_2 och i_3 nedan i storleksordning förutsatt att resistanserna är ordnade enligt $R_1 > R_2 > R_3$.

Poäng: 1



Välj ett svar

- ☐ a. $i_3 > i_2 > i_1$
- ☐ b. $i_1 > i_2 > i_3$
- ☐ c. $i_3 < i_2 < i_1$
- ☐ d. $i_1 < i_3 < i_2$
- ☐ e. $i_2 > i_3 > i_1$

7

Bestäm spänningen v_2 i [V] då $v_s=9$ [V], $R_1=8$ [Ohm] $R_2=8$ [Ohm]

Poäng: 1



Svar:

Purpose

- ▶ Help pacing the students
- ▶ Get them to think about concepts
- ▶ Give feedback to many with small teacher effort
- ▶ Get an overview of students' understanding of concepts
- ▶ Investigate new teaching aids

The tool (<http://moodle.org>)

The screenshot shows the Moodle.org website in a Mozilla Firefox browser window. The browser's address bar displays "Moodle Pty Ltd (AU) | https://moodle.org". The website's header features the Moodle logo, a navigation menu with links to About, News, Support, Community, Development, and Downloads, and a search bar. A welcome message states: "Welcome to the Moodle community! Moodle is a Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). It is a Free web application that educators can use to create effective online learning sites. Moodle.org is our community site where Moodle is made and discussed. Please use the menus to explore and join in!". Below this message is a grid of six icons representing different sections: About Moodle (graduation cap and 'm'), News (megaphone), Support (three people), Community (group of people), Development (tree), and Downloads (box with arrow). On the right side, there is a "Navigation" section with links to Courses, Developer credits, and Plugins. Below that is a "Latest news" section with a date and author. The browser window also shows the "You are not logged in" message and a language selector set to "English - United States (en_us)".

Moodle.org: open-source community-based tools for learning - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Moodle.org: open-source comm... | Moodle Pty Ltd (AU) | https://moodle.org

You are not logged in. (Login)
English - United States (en_us)

About News Support Community Development Downloads

Search moodle.org

Welcome to the Moodle community!

Moodle is a Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). It is a Free web application that educators can use to create effective online learning sites.

Moodle.org is our community site where Moodle is made and discussed. Please use the menus to explore and join in!

About Moodle

News

Support

Community

Development

Downloads

Navigation

Home

- Courses
- Developer credits
- Plugins

Official Moodle Partner:

Net Sapiens

- Konsulttjänster
- Support
- Integrationslösningar
- Utveckling
- Utbildning

Latest news

11:21am, Aug 5
Michael de Raadt

The courses

EIT moodle

You are not logged in. ([Login](#))
English (en)

Available Courses

[Advanced Computer Security 2012 - EITN50](#)
Teacher: Christopher Jämthagen
Teacher: Smeets Ben

Description:

In this course there will be 5 shorts quizzes. The purpose of these quizzes is to test your overall understanding in 5 different areas. Of the possible answers you have to choose the best alternative. You have 5 regular attempts to pass each quiz. You can do a quiz whenever you want after it is made available, except for that there is a mandatory waiting time between the first and second attempt. More info on [course web](#).

[Antenna Technology 2012 - ETEN10](#)
Teacher: Mats Gustafsson
Teacher: Anders J Johansson
Teacher: Marius Cismasu

[Computer Architecture 2012 - EITF20](#)
Teacher: Anders Ardö
Teacher: Michal Stala

[Datorarkitekturer med operativsystem 2012 - EDT621](#)
Teacher: Erik Larsson

[Digitala system 2012/2013 - EDI610](#)
Teacher: Erik Larsson

Calendar

August 2013

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

One course in particular

ETE115 Electromagnetics and electronics

- ▶ Basic course in electronics for second year Engineering Physics and Engineering Nanoscience, 7.5 ECTS
- ▶ Focus is on mathematical modelling, and analysis and interpretation of the models
- ▶ Mostly lectures and tutorials, a few labs
- ▶ The system has been used in many other courses, but not evaluated in a systematic way

Implementation

- ▶ Weekly quizzes, about 8 questions
- ▶ Limited time, but no limit on number of attempts
- ▶ Incentive: a (small) bonus on the written exam, if they have all the right answers for all weeks

Example: current division

ETE115_2013: Elektroniska frågor, test 1 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

ETE115_2013: Elektroniska fråg...

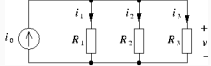
moodle.eit.lth.se/mod/quiz/attempt.php?q=293

Google

6 ⚡

Ordna strömmarna i_1 , i_2 och i_3 nedan i storleksordning förutsatt att resistanserna är ordnade enligt $R_1 > R_2 > R_3$.

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7 ⚡

Bestäm spänningen v_2 i [V] då $v_s=9$ [V], $R_1=8$ [Ohm] $R_2=8$ [Ohm]

Poäng: 1



Svar:

Example: Fresnel rhomb

ETEN05_2013: Oblique incidence, multilayer films - Mozilla Firefox

File Edit View History Bookmarks Tools Help

ETEN05_2013: Oblique incidenc... moodle.eit.lth.se/mod/quiz/attempt.php?q=328

Google

Electromagnetic Wave Propagation 2013 - ETEN05 You are logged in as Daniel Sjöberg (Logout)

ITM > ETEN05_2013 > Quizzes > Oblique incidence, multilayer films > Attempt 1

Update this Quiz

Info Results Preview Edit

Preview Oblique incidence, multilayer films

Start again

Note: This quiz is not currently available to your students

1 Marks: 1

How can the Fresnel rhomb convert linear polarization to circular?



Choose one answer.

- ☐ a. The rhomb material is anisotropic, causing a 90 degree phase shift between the linear polarizations along the optical axes.
- ☐ b. An antireflective coating is applied to the ends of the rhomb, which reduces the reflection at normal incidence.
- ☐ c. The phase of TE and TM reflection are different. By carefully choosing the angles of the rhomb, two reflections create a 90 degree phase shift between TE and TM polarization.

2 Which of the following alternatives does not correspond to Snell's law?

Example: possible feedback

ETEN05_2013: Fundamentals of wave propagation - Mozilla Firefox

File Edit View History Bookmarks Tools Help

ETEN05_2013: Fundamentals of... | moodle.eit.lth.se/mod/quiz/review.php?attempt=28354

2 Consider the complex wave vector $\mathbf{k} = (1 + 2j)\hat{x} + (2 - j)\hat{y}$. Which interpretation is correct?

Marks: 1

Choose one answer.

- ☒ a. Phase propagation in $\hat{x} + 2\hat{y}$, attenuation in $-2\hat{x} + \hat{y}$ ✓
- ☐ b. Phase propagation in $\hat{x} + 2\hat{y}$, attenuation in $2\hat{x} - \hat{y}$ ✗
- ☐ c. Phase propagation in $-\hat{x} + 2\hat{y}$, attenuation in $2\hat{x} - \hat{y}$ ✗
- ☐ d. Phase propagation in $-\hat{x} - 2\hat{y}$, attenuation in $-2\hat{x} + \hat{y}$ ✗

The propagation factor is $e^{-j\mathbf{k}\cdot\mathbf{r}} = e^{-j(x+2y)}e^{2x-y}$.

[Make comment or override grade](#)

Incorrect

Marks for this submission: 0/1.

3 Pair up the polarizations with the corresponding descriptions for a wave propagating in the positive z -direction. Assume time convention $e^{j\omega t}$.

Marks: 1

$\hat{x} - j\hat{y}$	Right hand circular polarization (RCP)	✓
$\hat{x} - 2j\hat{y}$	Left hand elliptic polarization	✗
$2\hat{x} + j\hat{y}$	Right hand elliptic polarization	✗
$\hat{x} + j\hat{y}$	Linear polarization	✗
$\hat{x}$	Left hand circular polarization (LCP)	✗

[Make comment or override grade](#)

Partially correct

Marks for this submission: 0.2/1.

Example: results (teacher view)

ETE115_2013: Elektroniska frågor, test 2 - Mozilla Firefox												
File Edit View History Bookmarks Tools Help												
ETE115_2013: Elektroniska fråg...												
moodle.eit.lth.se/mod/quiz/report.php?id=824&q=294&mode=overview&attemptsmode=0&qmfilter=0&page=19												
☐			17 april 2013, 10:32	17 april 2013, 10:47	14 minuter 43 Sekunder	10	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67
☐			17 april 2013, 10:34	17 april 2013, 10:41	6 minuter 47 Sekunder	10	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67
☐			17 april 2013, 10:23	17 april 2013, 13:06	2 timmar 42 minuter	8.89	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	0.56/1.67
☐			17 april 2013, 13:09	17 april 2013, 13:11	1 minut 57 Sekunder	10	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67
☐			17 april 2013, 13:34	-	öppen	-	-1.67	-1.67	-1.67	-1.67	-1.67	-1.67
☐			17 april 2013, 11:46	17 april 2013, 11:55	9 minuter 6 Sekunder	8.33	1.67/1.67	1.11/1.67	1.67/1.67	1.67/1.67	1.67/1.67	0.56/1.67
☐			17 april 2013, 11:56	17 april 2013, 11:58	2 minuter 11 Sekunder	8.33	1.67/1.67	0/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67
☐			17 april 2013, 11:58	17 april 2013, 11:59	1 minut 3 Sekunder	8.89	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	0.56/1.67
☐			17 april 2013, 12:00	17 april 2013, 12:01	1 minut 43 Sekunder	10	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67	1.67/1.67
☐			17 april 2013, 12:00	17 april 2013, 12:00	8 minuter 29 Sekunder	3.33	1.67/1.67	0/1.67	0/1.67	0/1.67	1.67/1.67	0/1.67

Example: analysis of components

ETE115_2013: Elektroniska frågor, test 1 - Mozilla Firefox

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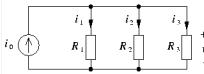
ETE115_2013: Elektroniska fråg...

moodle.eit.lth.se/mod/quiz/report.php?q=293&mode=analysis

Google

Strömrenning :
Ordna strömmarna i_1 , i_2 och i_3 nedan i storleksordning förutsatt att resistanserna är ordnade enligt $R_1 > R_2 > R_3$.

(4057)



$i_3 > i_2 > i_1$

(1,00)	0/496	(0%)	91%	0,288	0,98	0,65	
$i_1 > i_2 > i_3$	(0,00)	0/496	(0%)				
$i_3 < i_2 < i_1$	(0,00)	0/496	(0%)				
$i_1 < i_3 < i_2$	(0,00)	0/496	(0%)				
$i_2 > i_3 > i_1$	(0,00)	0/496	(0%)				
$i_1 > i_2 > i_3$	(0,00)	19/496	(4%)				
$i_3 > i_2 > i_1$	(0,00)	451/496	(91%)				
$i_3 < i_2 < i_1$	(0,00)	9/496	(2%)				
$i_1 < i_3 < i_2$	(0,00)	3/496	(1%)				
$(v_s) \cdot (R_1) / ((R_1) + (R_1))$							
Spänningsdelning : Bestäm spänningen v_2 i [V] då $v_s = \{v_s\}$ [V], $R_1 = \{R_1\}$ [Ohm] $R_2 = \{R_1\}$ [Ohm]	(1,00)	354/496	(71%)	71%	0,452	0,80	0,55

(4058)



What does the teacher have to do?

- ▶ Design good questions!!
- ▶ Get acquainted with the system in good time
- ▶ Put your self in the student's situation (e.g., as a user)
- ▶ Integrate the quizzes with the rest of the teaching

What can we get the students to do?

- ▶ Time spent varies a lot: from about 5 min to hours.
- ▶ Strong students: not much more work than usual.
- ▶ Weaker students: better in pace with the concepts.
- ▶ Some are just guessing their way (both strong and weak students).

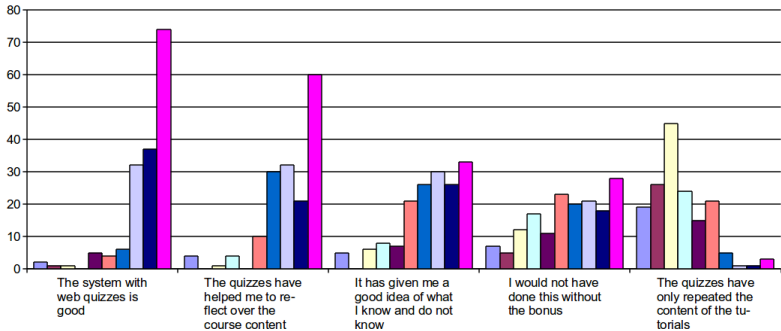
Evaluation

- ▶ The system has been evaluated in five course instances.
- ▶ Half time evaluation in four of them, after full time in one.
- ▶ Two different programmes (physics and nanoscience)
- ▶ In total 186 responses

Evaluation results

The students were asked to state their view on five propositions:

Left: does not agree --- Right: agrees



Some free text answers (translated from Swedish)

- ▶ Enables you to see how well you understand the course.
- ▶ The quizzes are a good and a bit different way of studying. . . a fun gam you can learn and benefit from.
- ▶ In the feedback, it would be good to get some page references on where to read more on the questions you fail.
- ▶ I think it is particularly good that there is sometimes feedback on why an answer is right or wrong. This makes you learn even though you used the wrong method, or guessed the answer.
- ▶ Some questions can be difficult to interpret.
- ▶ Remove the time limits [comment: some students want the quizzes re-opened as rehearsal for the written exam]

Conclusions from the evaluation

- ▶ The students use the system, and appreciate it
- ▶ It has helped them to reflect on the course content
- ▶ It has given them a reasonable idea of what they do know and what they do not
- ▶ There is a mixed impression of the bonus system
- ▶ The activity has not been a mere repetition of the other teaching activities

Pedagogical conclusions

- ▶ The students appreciate modern teaching activities that are well aligned with the course
- ▶ The system has encouraged the students to spend time with the subject matter
- ▶ The teacher has to do relatively little work (once the questions have been formulated)